netising force when that force is about 15 c.g.s. units. It is probable that by increasing the magnetising force sufficiently the signs of the effects would be reversed.

When torsion is carried beyond the elastic limit the effects become somewhat diminished, and when a permanent twist has been given, and the wire allowed to come back to its new zero of stress, reversals of the magnetising force then give feeble transient currents whose signs are opposite to those of the currents given when the wire is still under torsion.

In steel the general effect is less than in iron, but steel exhibits hysteresis more strongly. With copper, silver, brass, german-silver, and platinum, no effects whatever could be observed. In all probability the effects are peculiar to the strongly magnetic metals.

Having described the experimental results, the author proceeds to point out their relation to the discoveries of Thomson, Villari, Wiedemann, and Hughes, and attempts to explain the production of transient currents by the setting up of a state of circular magnetisation in the wire. Sir W. Thomson's discovery that aelotropic stress developes an aelotropic difference of magnetic susceptibility in iron may be used to account for circular magnetisation by the combined effects of longitudinal magnetisation and torsion. In order that the effects should have the signs which they actually had, this explanation would require that the magnetising force must have been, in all cases, below the Villari critical value at which the effects of push and pull on magnetisation are reversed. It is shown that this may possibly have been the case, and that the same assumption would explain away some of the contradictions between the author's results and the earlier ones of Matteucci.

The paper concludes with some general considerations regarding the phenomenon to which the name "hysteresis" has been applied.

VIII. "The Prehensores of Male Butterflies of the Genera *Ornithoptera* and *Papilio*." By PHILIP HENRY GOSSE, F.R.S. Received October 12, 1881.

(Abstract.)

Anatomists have long ago recognised, in insects, the existence of certain organs, intimately connected with the function of generation, yet perfectly distinct from the organs which perform the proper generative act. They are found only in the male sex; and are considered to have, as their sole use, the office of seizing and holding the female, during the act of coition.

In the detailed examination and comparison of these auxiliary

organs, in the *Lepidoptera*, little seems to have been yet done, except the memoir of Dr. F. Buchanan White, "On the Male Genital Armature in the European Rhopalocera," published in the "Trans. of the Linn. Soc." for December 21, 1876. His investigations prove that the variety which marks these organs—in form, position, and curious armature—is almost endless; and they have opened a quite new field of study in Comparative Entomology, eminently worthy of being further cultivated.

The researches of Dr. White were limited to European forms. The fine butterflies of the vast genus *Papilio*, being trans-European almost exclusively, are scarcely touched by him; and, for obvious reasons, these have been little submitted to destructive dissection and exhaustive examination.

The prehensile auxiliaries to generation, in the restricted genus *Papilio* (including *Ornithoptera*), I have been for some time examining; and I find the variety and singularity of the contrivances displayed therein certainly *not less* conspicuous than Dr. White's researches would lead us to expect. The results are emobdied in the present memoir, which comprises detailed descriptions of the male prehensile apparatus in sixty-nine species (viz., *Ornithoptera*, 11; *Papilio*, 58); illustrated by 196 drawings (viz., *Orn.* 29; *Pap.* 167) of the parts, magnified.

The organs which constitute the special subjects of examination are five in number, viz.:—

1. The Valve.
2. The Harpe.
3. The Uncus.
4. The Scaphium.
5. The Penis.

1. *The Valve.*—Every entomologist knows that the male sex of a swallowtail butterfly is distinguished by its abdomen terminating in two broad ovate plates, called the anal valves, articulated to the eighth segment; convex outwardly, concave inwardly; whose edges are in mutual contact during rest, inclosing and concealing an ample cavity.

2. *The Harpé.*—If we remove one of the valves, and examine its concave inner side, we find a peculiar appendage, to which I give the name of Harpe (ἅρπη), lodged within the hollow. It takes an infinite variety of forms, being never (so far as I have observed) the same in two species, however nearly they may be affined. It is, in general, a weapon of hard, horny chitine, usually glittering like glass, articulated in part to the base of the inclosing valve, in part to a projecting knob of chitine within the bottom of the eighth segment. It lies in the valve-cavity, to whose lining membrane it is affixed, to a certain extent;

but its distal moiety is free, projected, and antagonised to that of its opposite fellow.

It is in this free portion that the wondrous variety mainly resides; and the equally wondrous perfection of elaborate armature. It simulates, with curious precision, our knives, swords, sickles, axes, saws, and pikes, straight, angled, or curved; now furnished with one or more acute needle-points, now bearing a keen cutting edge, now cut into spinous teeth, now with each tooth notched into secondary minuter teeth; sometimes it is a broad disk, beset with conical prickles, sometimes a long elastic wire; besides many other forms, simple and compound, for which our human implements afford no comparisons.

That the proper specific office of these elaborate contrivances is the prehension of the female during the copulative act, is not left to be conjectured; for they often carry *documentary* evidence that they have been so employed. Very often, when a valve is exposed, the armature is quite invisible, because the cavity is wholly filled with a brown deposit, caked into a solid mass. This, when put on a slip of glass with a drop of water, under the microscope, is presently resolved into a multitude of body clothing-scales, clogged together with dried remains of what had been the anal fluid (*meconium*) of some female butterfly; that brown fluid which is always discharged soon after evolution from pupa. In such a case, conjunction had been effected with a female *just evolved;* the serrate harpe-claws of the male had scraped off a crowd of scales in the efforts to obtain prehension; while the excitement had caused the female to discharge the meconium at the same moment. And here remained the stereotyped record!

3. *The Uncus.*—The dorsal arch of the eighth abdominal segment terminates, generally, in a slender spine of polished, elastic chitine, which, continuing the medial line, projects backward, and arches down, so as to form a (more or less) semicircular hook. To this I appropriate the term *Uncus*. Its office seems to be to secure a *vertical* grasp of the female organs, which are simultaneously grasped, *laterally*, by the right and left harpes. But the shape, direction, curvature, texture, and adjuncts of this organ vary exceedingly; and sometimes it is altogether lacking.

4. *The Scaphium.*—This is an organ to which I have not been able to find distinct allusion in any author. In the other families of *Rhopalocera* it seems altogether wanting.* Yet, in the *Papilionidæ* proper, it is generally large, conspicuous, and complicate. If we remove the valve of *Ornithoptera Haliphron*, or *Papilio Pammon*, the

* Save in the *Pieridæ*. In the South American *Gonepteryges*, *Clorinde*, and *Leachiana*, it is well formed, but minute: in the Oriental *Hebomoia Glaucippe*, moderately large, but peculiar: it becomes evanescent in *Terias*.

eye is arrested at once by a great mass of firm flesh, white like polished ivory, projecting from the abdomen immediately under the *uncus:* this is the organ which, from a prevailing resemblance in shape to a boat, I call *Scaphium.* Of its function I remain ignorant: yet, since, in some species, it is most elaborately and formidably armed—as in *P. Macedon, Mayo, Thoas,* and, most of all, *Merope*—with teeth, and spines, and saws, I conclude that it must serve for prehension; though the question, "How?" is very difficult to answer; and though it very probably has *other* offices.

There is a manifest organic connexion between the scaphium and the uncus; like that organ it is occasionally wanting; but sometimes the uncus is present when the scaphium is absent, and sometimes the case is reversed.

5. *The Penis.*—This organ should strictly form no part of my subject, which is not the function of generation, nor the organs that perform it, but certain prehensile apparatus that are ancillary to the performance. The penis is a principal, not an auxiliary; yet, as it is essentially the centre, around which the whole armature waits and serves, and as it forms so conspicuous an object in the grouping of the whole, I could scarcely avoid representing it in the drawings, or giving some account, at least of its varying form and position.

Some curious phenomena, moreover, have occurred in the organ, which seemed to me worthy of being detailed and figured. Particularly the occasional development of a white pulpy tissue filling the chitinous tube, and evidently very distinct from it; and, in some instances, the extrusion of this tissue from the orifice, as a columnar or globular mass, which bears curious evidences of its having been forcibly extruded, in a condition at least semi-solid, and by successive spasms.

In some species, as the Oriental *P. Cöon* and its allies, this organ is excessively attenuated, and as excessively lengthened, so as protrude far beyond the limits of the valves, when these are normally closed; and so as to be quite apparent in the cabinet, like a projecting fine wire, with which one may readily take up and handle the specimen, as if it were an inserted pin.

All of these organs may be studied together, and with unusual facility, in *Ornithoptera Rhadamanthus* and in *Papilio Merope;* Plates I and IV of this memoir.

As the harpe appears to be the leading organ in the prehensile apparatus, the most fully elaborated and the most varied, I have employed its variations of form to cast into groups the species treated. This grouping is not proposed, in any sense, as a natural arrangement; but as a help to reference, and as a means of comparison of the varying conditions of the organ.

One of the results, not the least curious, of this grouping, is the

wide separation of species apparently very closely allied. Thus *Ornith. Haliphron* and *O. Amphrysus*, Cram., are radically different in the forms of their respective harpes. *P. Demoleus* and *P. Erithonius*, so very consimilar in the shape, colours, and patterns of their wings, are quite unlike in their harpes. *P. Bromius*, *P. Nireus*, and *P. Phorcas* have the harpe of a quite different *type* and *plan* in each! On the other hand, *P. Machaon* and *P. Arcturus* are consimilar in armature; while *P. Agavus* and *P. Hector* are as wide as the poles apart!

It must not be forgotten that the armature of not more than a sixth part of the 400 and upward described *Papiliones* is here represented. A further prosecution of the inquiry will certainly bridge-over many gaps, and supply other characteristic forms.

IX. "On the Propagation of Inhibitory Excitation in the Medulla Oblongata." By Dr. H. KRONECKER and Mr. S. MELTZER, Candidate in Medicine, Berlin. Communicated by Dr. BURDON SANDERSON, F.R.S. Received October 18, 1881.

In the Royal Academy of Science of Berlin, on the 24th January, 1881, a communication from us, "On the Mechanism of Deglutition and its Inhibitory Nerves," was read by Professor E. du Bois-Reymond. The experiments described were performed by means of a slightly inflated caoutchouc ball, fastened to the blind end of an œsophageal tube, the other end of which was connected with a Marey's tambour, whose lever recorded the movements on the blackened surface of a rotating cylinder. The ball was introduced, for varying distances, into the œsophagus, and the movements recorded resulting from the swallowing of small quantities of fluid.

It has previously been shown (Falk and Kronecker) that, in man and in the dog, the act of deglutition proper is accomplished by the quick contraction of the *striated* muscles, and that the draught reaches the stomach even before the œsophageal contraction can make itself effective. In one of our former investigations, Mr. Meltzer, by experiments performed on himself, showed that a mouthful of water reaches the stomach in less than 0·1 second after being swallowed, but that the peristaltic action does not appear in the uppermost part of the œsophagus sooner than about 1·0 second after the beginning of the act of deglutition, and does not reach the stomach till 5—6 seconds later. In the communication mentioned above, the results of still more recent investigations were given. It was found that in the uppermost portion of the œsophagus of man, extending about 6—8